

LASER DIODE ORDNANCE DESIGN

for the

**NASA AEROSPACE
PYROTECHNIC SYSTEMS WORKSHOP**

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Approved for public release; distribution is unlimited.

LASER DIODE ORDNANCE DESIGN

INTRODUCTION:

- **Technologies are now available to optimize vehicle ordnance performance, weight, safety, reliability and cost**
- **Maximum benefits achieved only through comprehensive ordnance to vehicle integration - Technology vs Requirements**
- **Laser Diode Ordnance provides one solution to meet the requirements for multiple aerospace applications**

LASER DIODE ORDNANCE DESIGN

CHARACTERISTICS:

- **Simple Electronic Controls and Safing**
 - **Adapts to multiple control and sequencing options**
 - **Hardened to stringent environments**
 - **Can be miniaturized**

- **Low Voltage System**
 - **No high voltage components**
 - **Prompt timing**

- **Inert Fiber Optics**
 - **Safe from electrical interference**
 - **Low light power for reduced impact on connector interface**

- **Insensitive Initiators**
 - **Secondary explosives**
 - **Fiber interface for electrical safety**

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SYSTEM DESCRIPTION:

- **Laser Firing Unit, Fiber Optic Cables and Initiators**
 - **Receives Command Control Signals and Power**
 - **Routing of Single or Multiple Fiber Cables**
 - **Explosive or Pyrotechnic Initiators**

Issues:

- **Centralized vs Distributed Design**
- **Number of Firing Units and Optical Connectors**
- **System vs. Component requirements**
- **System Reliability vs Component Margins**
- **Requirements Definition - Specification Intents**
 - **Barriers or Inhibits**
 - **BIT or Testability**

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LASER FIRING UNIT:

- Single or Multiple Laser Diode Outputs
 - Single Quantum Well Laser Diode, 850 nanometer wavelength
 - 2.5 watt output with 200 micron fiber
- Single Discrete Commands, 28 VDC power
- Single Fault Tolerant
- Independent and Verifiable Inhibits
- Weight and Volume, 1.5 lbs, 40 cubic inches for up to 6 outputs

Issues:

- Electrical and Mechanical Interface
- Laser Power
- Safing Design
- Built In-Test

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FIBER OPTIC CABLES:

- **Hard Clad or Glass-on-Glass Fibers**
 - **Diameters range from 100 microns to 400 microns**
 - **MIL-C-38999 connectors**
 - **Bend Radius - 0.5 inch for 200 micron fiber**
 - **Proof test up to 500,000 psi**

Issues:

- **Cable and Connectors Requirements**
- **Connector Losses**
 - **Contamination Characterization**

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INITIATORS:

- **Performance Duplicates Existing Devices (Detonators & Squibs)**
 - **Insensitive Explosives or Pyrotechnics**
 - **Hermetic (< 1 X 10⁻⁶ cc/sec He leak rate)**
 - **Fiber or Window Seal**
 - **Dichroic Coating**

Issues

- **Acceptable Explosive Materials**
- **No-Fire Levels**
- **Inadvertent Events and Levels**
- **BIT Level**

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CONCLUSIONS:

- **Launch vehicles, Satellites, Tactical Missiles, Strategic Missiles and Aircraft Ordnance Systems can be optimized for specific requirements**
- **Laser Diode Ordnance is a low risk solution for multiple applications**
- **Vehicle specifications for ordnance must be flexible to alternative technologies to achieve "Best Fit" design**